Food Labeling and Eco-friendly Consumption: Experimental Evidence from a Belgian Supermarket

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Abstract

Using an incentive-compatible framed field experiment, we investigate whether consumers' food consumption is more eco-friendly when the information about a product's environmental impact is more easily accessible. Through an online choice experiment, we identify a food label that is perceived to be the most easily accessible for assessing a product's eco-friendliness among six alternatives. This new graded food label is subsequently tested in an experimental food market embedded in a Belgium supermarket. We find that the presence of the new graded food label leads to more eco-friendly food consumption relative to the label currently used in the supermarket, i.e. the graded label increases the overall eco-friendliness of our subjects' food consumption by about 10%.

Key words: Food labelling, Field Experiment, Environmental Information Provision, Consumer Behaviour

1. INTRODUCTION

Many consumers seem to give little thought to the links between their consumption behaviors and the process of food production (de Boer et al. 2009). Food consumption however is one of the most important areas to improve environmental sustainability since it is responsible for one third of a household's total environmental impact (European Environment Agency, 2005). Hence, changing households' consumer behavior can be considered as a powerful option to reduce the use of natural resources (Gerbens-Leenes and Nonhebel, 2002). Although many studies indicate that most consumers claim to be willing to pay for environmentally superior food products, the share of eco-friendly produced food in total consumption has remained low (Padel and Foster, 2005; Rousseau and Vranken, 2013). This gap between consumers' attitude and their actual buying behavior has been referred to as the attitude/behavior gap (Vermeir and Verbeke, 2008). A critical question hence remains the extent to which consumers' expressed interest can be turned into actual purchasing behavior. Our study shows that communicating environmental information more efficiently is effective at reducing this gap.

The attitude/behavior gap exists partly because the information provided in actual food markets is uninformative of a product's environmental impact (Thibert and Badami, 2011; Schumacher, 2010). The existing labeling schemes emphasize only one single environmentally relevant factor, such as whether a product is organic, its carbon emissions or its place of origin (Ridoutt et al., 2011). Consumers can infer little from such fragmented information about a product's overall environmental impact. Thus, even people who are motivated to consume more eco-friendly products have to rely on heuristics or rule of thumbs, such as whether a product is organic or local, and these signals are imperfect, and at times even misleading, for assessing the overall environmental impact. Moreover, these heuristics gave rise to the common misperception that eco-friendly food is necessarily more costly (Bravo et al., 2013). In addition, green-wash news[1], the multitude of eco-labels and the eco-labels high degree of diversity make it difficult for consumers to use these labels as a reliable standard due to information overload and the potential adverse effects resulting from consumer indifference or misunderstanding (Lozano et al., 2010; Van Amstel et al., 2008; Verbeke, 2008). Consumers thus find it difficult to understand which products are actually eco-friendly and they do not know where to turn in order to be able to differentiate between dirty and green products (Schumacher, 2010). If it is true that the average consumer does have a preference for eco-friendliness and that the attitude/behavior gap is merely due to the poor accessibility and reliability of the relevant information, then the environmental impact of food consumption can be greatly improved by designing more user-friendly food labels that effectively and reliably convey the eco-friendliness of a product.

Our paper focuses on three channels to make the information of environmental impact more accessible so consumers can make ecologically responsible food choices. First, the food label must include more criteria-specific information to account for the interaction among the diverse environmental impacts (Thibert and Badami, 2011; Gerbens-Leenes et al., 2003). Recently, the introduction of a multi-criteria environmental information label based on the life-cycle approach [2] has been proposed as a possible solution to the questionable informational content and reliability of current labeling schemes (European Food SCP Round Table, 2012; Schumacher, 2010). To the best of our knowledge, there is no scientific evidence yet that directly supports the idea that the introduction of a multi-criteria labeling scheme will have a behavioral impact. Second, how environmental information is presented can matter

[1] The release of information to consumers about false environmental efforts alleged by firms (Lozano et al., 2010).
[2] Life-cycle analysis is a technique to assess environmental impacts associated with all stages of a product's life.

(Van Amstel et al., 2008; Levy et al., 1996). We hypothesize that a normalized color scale is more accessible relative to raw information since it is difficult for non-experts to evaluate the impact of raw environmental information (Zander and Hamm, 2012). Last but not least, a standardized score or grade of the overall environmental impact can be added to ease the cognitive load of consumers in processing the information and to urge producers to implement product eco-innovations (Triguero et al., 2013; Teisl and Roe, 1998). We explore whether the introduction of a new label with more reliable, standardized and easily comprehensible environmental information applied to all products leads to more eco-friendly food consumption.

Needless to say, our intuition of a new label's ability to convey information should be empirically tested before any conclusive policy recommendation of introducing it in real food markets can be made. There are very few studies that examine demand for eco-labeled goods using observed purchase decisions of consumers (Brouhle and Khanna, 2012). So far, the plethora of studies examining consumers' attitudes towards and willingness-to-pay for environmentally superior products rely only on stated preference methods and lab experiments (Bravo et al., 2013; Lusk et al., 2011; Birol & Koundouri, 2008; D'Souza et al., 2007). Stated preference studies are relatively easy to conduct, but they only measure attitudes, not behaviour. When asked hypothetical questions that affect subjects' social image, consumers are more likely to overstate their attitude (Cummings et al., 1995). Lab experiments, however, are prone to issues of external validity such as the fact that they are conducted in unfamiliar environments using non-representative samples, and are prone to experimental demand effects (Alfnes and Rickertsen, 2011; Levitt and List, 2007). In other words, the behavioural response to the new label in the lab might differ from the behavioural response in a real supermarket.

In this paper, we use a two-step approach. As a first step, we elicit consumers' ratings of six alternative labels in terms of the accessibility of the environmental impact information through an online choice experiment. We then conduct a framed field experiment to investigate the impact of the preselected labels on actual purchasing behaviour. In particular, we introduce an incentive-compatible experimental food market in a natural consumer environment, namely the supermarket. A framed field experiment combines the controllability of a lab with the heightened external validity of a field experiment (Harrison and List, 2004). By creating a natural food consumption environment with real supermarket food stands, we try to overcome aforementioned problems associated with a lab setting that may induce artificial changes in behaviour (Benz and Meier, 2008; Lusk et al., 2011). In addition, real products and actual cash are transacted, which makes the experimental market both non-hypothetical and incentive compatible, aligning attitudes closer with corresponding behaviour (Lusk and Shogren, 2007). Nevertheless, since our food market is still a controlled lab in an isolated corner of a supermarket, we preserve the power to investigate the causal effects of introducing a new label.

2. METHOD

This section covers how we selected the food products to be purchased in the experimental food market, how we determined the environmental impact of each selected product and how the environmental impact information was presented.

2.1. Product choice

To investigate the substitution effect among products, we use three product stands covering the three main categories of daily food consumption: a vegetable stand, a fruit stand and a protein stand. To make the experimental market more natural and realistic, we use an open supermarket refrigerator for the protein products, and the typical supermarket stands for fruit and vegetables. We place fruit and vegetables loosely (in units) without the original packaging in straw baskets to refine the treatment effect on the actual quantity change. For the protein stand, products are kept in their original packaging for food security reasons.

For the vegetable stand, we include three tomato variants: conventional-Belgian, organic-Belgian and conventional-Spanish. The three tomato variants show strong product similarity with respect to their visual appearance. For the fruit stand, we include three apple variants: conventional-Belgian, organic-Belgian and conventional-New Zealand. The two Belgian apples are of the Jonagold variety while the New Zealand one is of the Gala variety. Therefore, there is less product similarity in appearance for apples than for tomatoes. For the protein stand, we include two animal and one plant-based food products: a beefsteak, a chicken breast or a veggie burger.

The prices for these nine different products are kept exactly the same as those set by the supermarket. The only treatment manipulation is the information provided about the products' environmental impact.

2.2. *Creation of Environmental Impact Label*

Using LCA data (Vlaeminck et al., 2014), we assess the environmental impact of the products presented in the experimental food market and create six different environmental impact labels (Figure 1). These labels vary in the degree to which the LCA data are aggregated and translated into environmental impacts, ranging from raw information, information translated into a normalized color scale, to a comprehensive overall score.

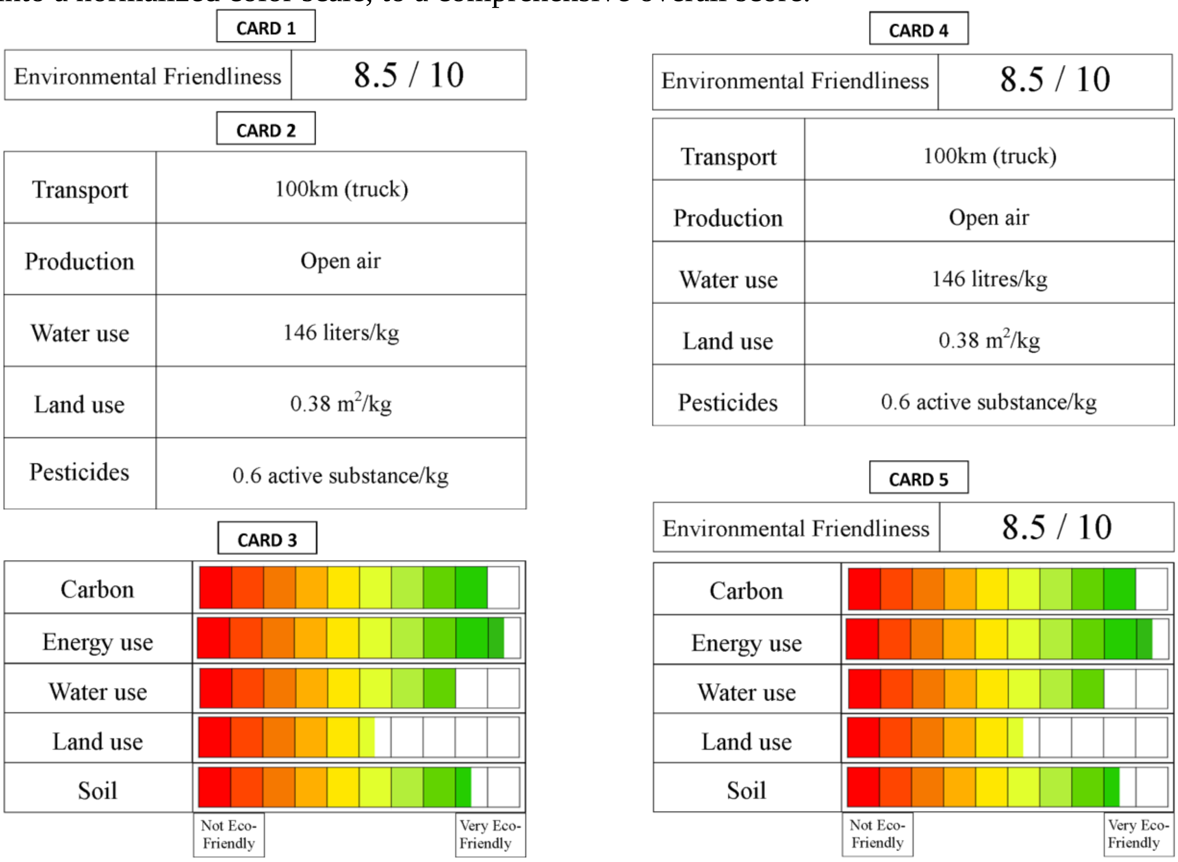

Figure 1. Example of environmental information cards. Card 2 is the least effective label used in *Treatment Least*. Card 5 is the most effective label used in *Treatment Most.* Card 6 consists of Card1+Card2+Card3.

2.3. Selection of labels to be used for different information treatments

Before testing the behavioural impact of a new label through a field experiment, we screen out the labels that are perceived to be less effective in conveying the environmental impacts. We pre-test the six labels on their effectiveness through an on-line survey using a hypothetical choice experiment and a ranking elicitation. Respondents have to indicate which apple they prefer between two apples in six hypothetical choices based on the information provided on the labels. We ask participants to assume that price, origin, environmental impact and other characteristics are the same for the two apples. In that way we assess the effect of the cards' clarity on product choice. After making their choices, respondents rank the six labels from most clear to least clear. This allows us to identify the least and most effective labels in conveying environmental information. We use the label that is ineffective in conveying environmental information as a control for the mere information effect, since previous studies have shown that receiving information, whatever its content, may already affect the purchasing decision (Bougherara and Combris, 2009).

2.4. Experimental procedure and design of food market

The experimental food market is set up in an isolated corner adjacent to the main entrance hall of a Belgian retail supermarket. Participants complete a questionnaire both before and after participating in the experiment. The experiment proceeds as follows:

Figure 2. Diagram of the experimental procedure

In step 1, all customers are recruited in the main entrance hall of the supermarket with the same message: "Hello. We are from the KU Leuven and we are doing innovative research. We are interested in how we can better aid consumers in their shopping experience and how much information therefore needs to be present in the supermarket atmosphere. Therefore we ask whether you would like to participate in this research. In total it takes ten minutes and you will receive a 10 euro reward for your participation at the end of the study."

In step 2, participants fill in a pre-questionnaire that includes a short version of the Marlowe-Crowne Social Desirability Scale (Marlowe and Crowne, 1960) as well as a few questions on socio-demographics.

In step 3, after the participant finishes the questionnaire, the researcher explains the rules of the experimental food market before she shops in the experimental food market: (1) buy at least one product from each of the three stands (2) use the 10 euro reward as credit (3) take home the products you choose (4) consider the trade-off between leaving the study with more products or with more cash. The researcher then leaves the food market and only comes back when the participant finishes shopping. There is only one participant at a time shopping.

In step 4, the participant fills in a post-questionnaire that elicits individuals' food consumption habits, environmental knowledge and preferences for eco-friendly food products. In step 5, the participant receives his purchases and the remaining budget in cash.

We only recruit people that enter the supermarket and hence have the intention to do grocery shopping. In this way, we limit the chance that the purchases in our market become redundant. The food label is switched after each participant to prevent a time of the day effect. We randomize the position of the food products in order to prevent a position effect. We also ensure that participants are exposed to equal amounts of products so as to prevent a product popularity effect.

3. DATA AND RESULTS

3.1. Selection of labels and the information treatments

An online survey to determine the most and least effective label was conducted in August 2012, and a total of 230 respondents completed the hypothetical choices and ranking exercise. We analyse the choices with the conditional logit model and compare them to the ranking results. Conditional logit estimations and the results of the contingent ranking exercise indicate that respondents prefer the label that combines information on environmental impact at attribute level with the overall environmental score at product level the most (card 5 in Fig.1), and the label that only depicts raw information (card 2 in Fig. 1) the least. The results allow us to select the least and most effective label -- in their ability to convey the environmental impacts -- for the information treatments used in the experimental market.

The experimental food market consists of three treatments. In *Treatment Control*, we do not provide extra information on the label except for the information already available in the supermarket. *Treatment Control* thus serves as the baseline for the purchases participants make in the present supermarkets. In *Treatment Least*, we install the label that only depicts 'raw' information (see card 2 in Figure 1). *Treatment Least* is used to control for the information effect per se and to see whether the introduction of a label, although being the least effective in delivering the information, already has an effect on purchasing behaviour. In *Treatment Most*, we install the label that combines the information of environmental impacts for each attribute with the overall environmental score at the product level, the one that was perceived by the consumers as the most preferable in delivering eco-friendliness information (see card 5 in Figure 1).

3.2. Experiment

3.2.1. Descriptive statistics

We conducted the experiment in a local supermarket in January 2013. A pilot study was run 6 months earlier to fine-tune the details of the experiment. The target of 150 participants (50 per information treatment) was reached during the ninth day of the experiment. 150 participants were randomly allocated over the three information treatments in the experimental food market. Except for the information treatment, the experiment remained exactly the same for all three groups.

We test for differences in socio-demographics and food consumption habits between treatment groups because the internal validity of a randomized design is maximized when one knows that the samples in each treatment are identical (Harrison and List, 2004). The treatment groups' socio-demographics, food consumption habits and health concerns do not differ between treatments at the statistical significant levels.

3.2.2 Market shares and product choice per information treatment

Table 1 shows the descriptive results of the information treatment effect on the market share of each experimental product. Compared to the *Control Treatment*, the market share of the most eco-friendly alternative in *Treatment Most* increases substantially in all of the three categories*:* the share of Spanish conventional tomatoes increases by 178%; the share of Belgium organic apples increases by 44% and the share of the veggie burger also increases by 178%. Moreover, the increased market shares of the most eco-friendly alternatives were in substitution of the least eco-friendly alternatives. In *Treatment Least*, although the share of the most environmental friendly alternative increases in both the fruit and the protein categories, it was in substitution of the second best alternative. The share of the least eco-friendly alternatives such as the New Zealand apple and the steak does not decrease. Moreover, the share of the Spanish conventional tomatoes decreases, substituted by the organic local variant.

Table 1. Food products' market shares per treatment

Food Products	Price	EF Score	Market shares per Treatment Control	Least	Most	%Change Most/ Control
BE Conv. Tomato	€2.49/kg	6.5/10	50%	50%	34%	-35%
BE Org. Tomato	€5.53/kg	6.5/10	32%	38%	16%	-50%
SP Conv. Tomato	€2.54/kg	7/10	18%	12%	50%	178%
		Pearson Chi-square = 22.07 Pr = 0.000				
NZ Conv. Apple	€2.43/kg	7.5/10	22%	22%	10%	-58%
BE Conv. Apple	€2.49/kg	8.5/10	46%	34%	46%	4%
BE Org. Apple	€3.32/kg	9/10	32%	44%	44%	44%
		Pearson Chi-square = 5.01 Pr = 0.286				
Steak	€2.89	1.5/10	24%	30%	18%	-35%
Chicken	€2.71	3.5/10	62%	44%	50%	-50%
Veggie Burger	€2.79	5/10	14%	26%	32%	178%
		Pearson Chi-square = 6.62 Pr = 0.158				

EF Score: Eco-friendliness Score;
BE: Belgium; SP: Spain; NZ: New Zealand; Conv: Conventional; Org: Organic

We now present the results of the multinomial logistic regressions of the treatment effects on the likelihood of choosing a specific type of product within a food stand (product category) (see Table 2).

Table 2. Multinomial regression estimates for product choice in food market

Food Products	EF Score	Product Choice Treatment Least	Treatment Most	Log Likelihood
BE Conv. Tomato	6.5/10	0.405 (0.598)	-1.407*** (0.500)	-139.31 (χ^2(4) =17.59 ***)
BE Org. Tomato	6.5/10	0.577 (0.627)	-1.715*** (0.582)	
SP Conv. Tomato	7/10	Reference Category		
NZ Conv. Apple	7.5/10	-0.318 (0.538)	-1.107* (0.632)	-153.24 (χ^2 (4) =5.38)
BE Conv. Apple	8.5/10	-0.621 (0.459)	-0.318 (0.441)	
BE Org. Apple	9/10	Reference Category		
Steak	1.5/10	-0.396 (0.608)	-1.114* (0.632)	-150.33 (χ^2 (4) =6.85)
Chicken	3.5/10	-0.962* (0.545)	-1.042** (0.527)	
Veggie Burger	5/10	Reference Category		

Note: As a rule, we choose the most eco-friendly product variety as the reference category.
Observations: 150; Standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1;
EF Score: Eco-friendliness Score;
BE: Belgium; SP: Spain; NZ: New Zealand; Conv: Conventional; Org: Organic

As shown in Table 2, consumers' consumptions shifted away from less eco-friendly alternatives in all categories in Treatment Most. The likelihood of consumers choosing the two less friendly alternatives is lower relative to the most eco-friendly alternative within each food category. The negative coefficients are both economically and statistically significant at least at the 10% level for all alternatives except for the Belgian conventional apple. One potential explanation is that the most eco-friendly apple is a relatively more expensive alternative. In *Treatment Least*, although consumers also shifted their demand away from the less friendly alternatives in the fruit and protein categories, the negative coefficients are not statistically significant except for chicken. Hence, we do not find any strong supporting evidence for the mere information effect.

3.2.3 Eco-friendliness of consumer baskets per treatment

Finally, we explore the information treatments effects on the average eco-friendliness per calorie. For each individual consumer basket, we calculate the average weighted friendliness per calorie as the sum of the LCA scores (Score $_i$) of the products in his/her basket weighted for their caloric share to the total basket calories:

$$EF_{consumerbasket} = \frac{1}{\sum_{i=1}^{9} weight_i * Calorie_i} * \sum_{i=1}^{9} [Score_i * weight_i * Calorie_i]$$

where i stands for the nine products in the food market, *score* for the eco-friendliness score at product level per kilogram, *calorie* for the amount of calories per kilo and *weight* for the amount of product (in kilo).

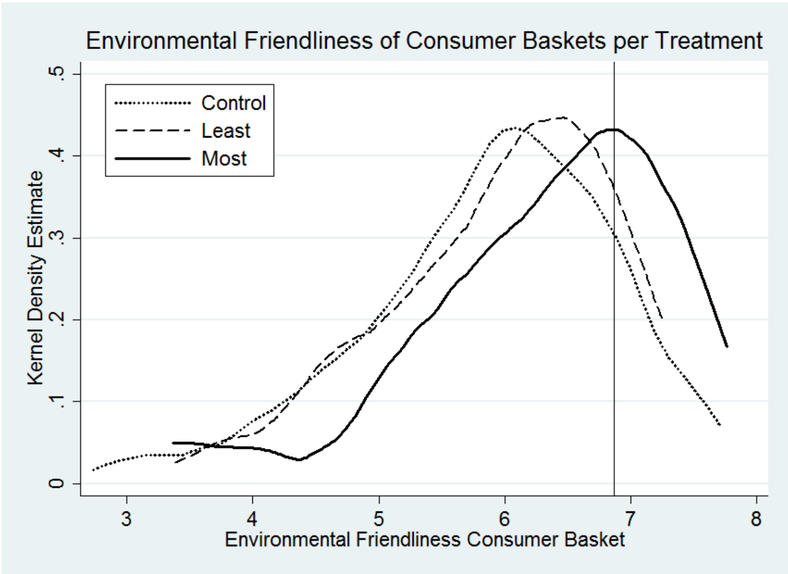

Figure 3. The eco-friendliness of consumer baskets per treatment

Figure 3 depicts the distribution of the consumer baskets' eco-friendliness per calorie of the three information treatments.[3] In the *Control Treatment* the distribution of consumers' eco-friendliness peaks around six, while in *Treatment Most* it peaks around seven. The results of the two-tailed Mann-Whitney-Wilcoxon tests show a significant difference between *Treatment Least* and *Treatment Most* (z = -2.054, p = 0.039) and between *Treatment Control* and *Treatment Most* (z = - 2.461 and p = 0.014), but not between the *Control Treatment* and *Treatment Least* (z = -0.496, p = 0.619). As a robustness check, we also run the same tests comparing the consumer baskets' eco-friendliness across treatment based on the weight of the product instead of the calories, the results are robust. Altogether, these results show that the preselected label with the most accessible environmental information increases the overall eco-friendliness of our subjects' food consumption by about 10%.

4. DISCUSSION

In *Treatment Least* in which we installed the label with only 'raw' information, we find no effect of the additional environmental information provided on the product choices compared to *Treatment Control* partly because the 'raw' information is not easily interpretable with small absolute differences for each attribute. For the protein category, however, we find a significant substitution effect of chicken and veggie burgers since the 'raw' information is slightly more intuitive (at least in magnitude) given the more pronounced absolute differences in the attributes. For example, while the water use for the Belgian organic

[3] We employ Epanechnikov kernel functions with bandwidth = 0.35 according to Silverman's rule of thumb.

apple and the New Zealand conventional apple is 146 and 220 litres/kg respectively, for steak and veggie burger the water use is 11000 and 1106 litres/kg respectively.

In *Treatment Most*, we installed the label that combines information on environmental impact at attribute level with the overall environmental score at product level. We find an overall effect in favour of the most eco-friendly alternative. However, the specific characteristics of each product stand determine how switching behaviour manifests itself.

For fresh produce, people generally buy local or organic because this information is likely used as a heuristic for the eco-friendliness of the product (amongst other things).[4] The high initial market shares for local and/or organic fruits (78%) and vegetables (82%) in *Treatment Control* confirm that people use the local-organic heuristic or are at least more attracted to products possessing these attributes in our experimental market. Thus, without introducing the most effective label, both groups behave in a very similar way.

With the most effective label installed in the vegetable group, people realized that the organic alternative is actually inferior in eco-friendliness (EF: 6.5/10) compared to the conventional foreign (EF: 7/10). Indeed, the results show that such a label was effective in empowering consumers to be free from a heuristic trap.

As for the fruit, participants have the choice between one environmentally inferior (7.5/10) option, being the foreign conventional apple, and two environmentally superior options (8.5 & 9/10), i.e. the local conventional and local organic apple. Since consumers already bought more frequently the more superior alternatives in the Control Treatment, one would expect a less significant behavioural impact. Nevertheless, we see that *Treatment Most* still shifts a substantial part of the demand away from the least eco-friendly alternative towards the most eco-friendly alternative.

As for the protein stand, participants can choose between (1) an evidently inferior environmental option, i.e. steak (1.5/10), (2) a less inferior option, i.e. chicken (3.5/10), and (3) a superior alternative, i.e. the veggie burger (5/10). We find that consumers choose less steak and chicken in favour of veggie burgers. The combined finding of choosing less steak and less chicken may indicate a trickle-down effect of steak buyers substituting steak for chicken and chicken buyers substituting chicken for veggie burgers. The overall result indicates a switch induced in Treatment Most from buying meat to vegetarian alternatives.

Finally, we recognize the high initial market shares for organic produce (±30%) in the experimental food market compared with the actual market shares for organic produce (±5%) (Samborski and Van Bellegem, 2013). The experimental food market seems to introduce an upward bias in organic market shares. This is consistent with other studies (e.g. Fox et al., 1998; List and Shogren, 1998; Marette, 2008) showing that field valuations can be greater than laboratory valuations. The upward bias can be a result from a house money effect where the provision of an initial endowment can cause experimental subjects to make unusual choices (Clark, 2002). In addition, the high organic share may indicate that people buy more socially desirable in the experimental market even if nothing has been said about eco-friendliness (Johansson-Stenman and Svedsäter, 2012). As such, the experimental food market might not be an accurate predictor of actual market shares and, as a consequence, neither of the magnitude of the changes in market shares. However, there is no specific reason to believe that the direction of switching behaviour observed in the experimental food market would differ from the switching direction that would be observed in an actual market. In other words, the reference point, that is, the control treatment's initial share, may be biased upwards, but the switch in purchasing behaviour is consistent (Ariely et al., 2003). Therefore

[4] Buying local and/or organic also originates from other aspects such as quality, healthiness and support of the local economy. We just want to point out that organic and local are the major heuristics (beside seasonality) people use for fresh produce when they want to be more eco-friendly.

switching behaviour in the experimental food market can be a good indicator for switching behaviour in an actual market.

5. CONCLUSION

This paper explores whether the introduction of a more complete, easily-interpretable and standardized label promotes eco-friendly consumption. Using an incentive-compatible experimental market in a Belgian supermarket with real products, we show that consumer attitudes translate into more corresponding eco-friendly behaviour when the eco-friendliness information of the food products are more accessible. We find that the best environmental information label preselected in a prior survey substantially steer consumers towards more eco-friendly food purchases. We also find evidence that the new label can overrule the often-used heuristics such as “think global, eat local” or “organic is more eco-friendly”. Accordingly, we highlight the considerable potential for policy makers to encourage eco-friendly consumption through the provision of an easy-to-interpret and standardized environmental information label.

Given that the process of creating and adopting a commonly applied label in all supermarkets is slow and costly, it is all the more important for the relevant research to develop methods to pre-test the new label’s behavioural impacts through systematic experimentation. Our paper made such an endeavour, and our experimental finding that the multi-criteria label with a standardized score as used in this paper significantly promotes eco-friendly food consumption can serve as a piece of scientific evidence for public authorities and companies to further explore and implement a new graded food label.

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